*inversa*, Rudolphi, may almost be said to line the intestine of *Sterna fissipes*. A very common species, which is perhaps *Tænia lævigata*, Rudolphi, but which may perhaps be new, develops itself indifferently in the curlew, the sanderling, the common turnstone, the variable sandpiper, and the knot. The genus *Ophryocotyle*, established by Friis in 1869, is represented at Roscoff by two species. *Ophryocotyle proteus*, Friis, is found in the variable sandpiper and the sanderling as well as in the ringed plover; the other species is new, and lives in the godwit.

The parasites of the Cetacea of the suborder Cetodontes have been lately carefully collected; but it is probable that we are still far from knowing all. In a common dolphin, dissected in the laboratory of Roscoff on June 22nd, 1874, we found at the base of the pectoral fins, between the fat and the muscles, a singular worm, which I have been unable to determine, and of which I will shortly give a description. This curious parasite seemed to me to resemble the *Pseudalii*; but it certainly differs from all the species of this genus at present known. The same dolphin contained in its stomach a prodigious quantity of *Ascaris simplex*, Rudolphi, in all stages of development.

I may also notice as being found at Roscoff two unpublished *Cercariæ*, the *Rediæ* of which live in marine Mollusca. One of them, discovered by Professor de Lacaze-Duthiers, is a parasite of *Calyptræa sinensis*, and is distinguished by its tail, which is furnished with two membranous lateral expansions, regularly plaited across. The other, which much resembles two *Cercariæ* described by Müller (*C. setifera* and *C. elegans*), is a parasite on *Nassa reticulata*.

We have still to study the migrations and metamorphoses of all these species. The subject is without doubt very attractive; but it requires much method and circumspection and a long series of observations. It will be this year the principal object of my researches. Some experiments I have made in this direction on the parasites of the birds have not been unfruitful, and I hope soon to be able to communicate to the Academy the results obtained.—*Comptes Rendus*, April 26, 1875, p. 1098.

### *On the Action of Borax in Fermentation and Putrefaction.*

By M. J.-B. Schnetzler.

In the scientific discussion which took place before the Academy between MM. Pasteur and Fremy on the theory of fermentation M. Dumas intervened, stating that there are two sorts of ferments:—those of which beer-yeast is the type, which live and multiply during the fermentation; and those represented by diastase, which, on the contrary, are destroyed during their action*.

Restricting the name to the chemical action produced by ferments

* Revue des Cours scientifiques, 1872.

of the first type, M. Dumas arrives at this conclusion, that fermentation is a chemical phenomenon accomplished under the necessary influence of the life of the ferment. After investigating the action of a great number of substances on yeast, the illustrious chemist examines the properties of borax. This substance coagulates yeast, dissolves the membranes which remain in suspension in an unfiltered solution of white of egg, prevents the conversion of the sugar by the water of the yeast, arrests the action of diastase, and paralyzes synaptase. M. Dumas expects that the study of borax will lead to consequences of the highest importance.

M. Dumas's communication forms the starting-point of the following observations and experiments.

I. *The Action of Borax on the Protoplasm of Vegetable Cells.*

1. Some leaves of *Elodea canadensis* (the rotation of the protoplasm in the cells of which is readily observed) were immersed in a concentrated solution of borax. The plasmatic current continues for some minutes, then becomes slower and stops altogether. The protoplasm contracts, retires from the cell-wall, and condenses into one or two rounded masses enclosing grains of chlorophyl. The borax has killed the living material of the cell.

2. In observing the issue of the spores of *Vaucheria clavata* in water, I was able to verify, in the long tubular cell of some individuals which did not possess spores, movements of contraction of the protoplasm, which became differentiated into green balls moving in different directions in the interior of the cell. When, by a slight pressure, the protoplasm is expelled from the cell, either in balls or in shapeless masses, there are still perceived in it for a little time lively molecular movements.

On immersing fresh and intact *Vaucheriæ* in a concentrated solution of borax, the protoplasm coagulates and retires from the cell-wall, which becomes perfectly hyaline.

The action produced by borax on the globules of chlorophyl is striking; they contract, and bend themselves into the shape of a crescent.

The spores of *Vaucheria*, after coming out of the mother cell, execute in water rapid movements of translation by means of their minute vibrating cilia. In a borax solution these movements are almost instantly arrested, the protoplasm of the spore contracts and is transformed into a finely granular mass within the cell.

3. I watched the effect of a solution of borax upon *Oïdium Tuckeri*, which had attacked some grapes. In pure water, molecular movements are observed within the hyphæ and spores, independent of the plasmatic currents. The material contained in the cells of the fungus exhibits the same molecular movements when by a slight pressure it is diffused in water. Under the influence of a solution of borax the spores and hyphæ of the *Oïdium* contract; the latter twist, while their contents coagulate into a granular mass: the fungus is killed. The molecular movements of the substance that

has come out of the cells continue in the borax solution. It is in the same manner that borax produces coagulation of the protoplasm of the cells of yeast, moulds, &c.

II. *The Action of Borax on the Animal Organism.*

1. Infusoria, Rotifera, and Entomostraca, placed in the same drop of water, to which is added concentrated solution of borax, soon cease their movements and die. The contraction and coagulation of the sarcode of the Infusoria is distinctly perceived.

2. Young tadpoles rendered very transparent by a prolonged stay in darkness, placed in solution of borax, exhibit convulsive contractions in the muscular fibres of the tail; the circulation of the blood (so easy to observe in these animals) gradually slackens; the plasma of the blood coagulates; and in less than an hour the animal is dead.

The preceding observations show that borax puts an end to the properties by which the life of protoplasm, vegetable and animal, is manifested. If fermentation is a chemical phenomenon effected under the influence of the life of the yeast, borax must necessarily counteract fermentation.

III. *The Action of Borax on Fermentable Substances.*

1. In the month of October 1872, I placed some very ripe grapes in a concentrated solution of borax, as well as an entire bunch of grapes; the whole was put into a bottle and corked up. The liquid, at first colourless, browned slightly; but the separate berries, as well as the bunch, present the same appearance to-day (February 1875) that they did more than two years since. There has been no trace of fermentation. Nevertheless, although the grapes are well preserved, they are not eatable. There has been diffusion: a large portion of the sugar has passed through the membranous husk of the grapes, while the borax has penetrated into the interior, where it has coagulated the albuminous matter of the cells.

I made the same experiment with some gooseberries, and obtained the same result. When the bottles are well corked, not a trace of mouldiness can be seen; but when the air has free access, or even a limited access, a mouldiness forms (*Mucor*) without fermentation accompanied by disengagement of gas. When, as a countertest, grapes are placed in a well-corked bottle filled with water, fermentation takes place at the end of a time which varies according to the temperature, and carbonic acid is liberated.

2. 30 cubic centims. of fresh milk was put into a test-tube with 1 gramme of borax. The cream soon formed a pretty thick layer at the surface. In spite of the stopper which closed the test-tube, mould formed on the cream; but the rest of the liquid underwent no acid fermentation, and retained during several months the look of skimmed milk, very clear. Afterwards, under the influence of

the heat of summer, the liquid became quite limpid, while a soft white substance (caseine) was deposited at the bottom of the tube; but neither the liquid nor the precipitate had any acid taste; at the end of three months they exhaled the odour of fresh milk.

Some fresh milk, without the addition of borax, put into a well-corked test-tube, underwent the acid fermentation after two or three days; it became quite thick by the coagulation of the caseine.

3. A fragment of sheep's cerebellum was sprinkled with borax. Eight days afterwards it gave out a spermatic odour; later, sulphuretted hydrogen was liberated, without putrefaction proper being perceptible. The substance, after presenting during several months a soft consistence, became hard and void of any unpleasant smell.

4. A pound of beef was placed in a concentrated solution of borax in a tin box not hermetically sealed. The red colouring-matter of the blood became diffused in the surrounding liquid, as well as a part of the soluble nitrogenous substances of the meat. After a few weeks the liquid assumed a brown colour and emitted a very unpleasant odour, although there was no putrefaction of the meat, which, when removed from the liquid and washed with cold water, certainly had a peculiar smell, but quite unlike that of putrefying meat. To-day, after more than a year and a half, notwithstanding the summer heats of 1873 and 1874, the liquid having been renewed three times, the flesh presents not the slightest odour of putrefaction. Its colour is yellowish; but it is soft and tender like fresh meat. Taken out of the preserving-liquor, it retains its condition unchanged in the air.

5. Some beef, veal, and fragments of sheep's brains were placed in a borax solution in a jar filled with the liquid, and hermetically closed. The liquid was soon tinged bright red; and this colour remained unchanged during several months. The meat did not present the slightest unpleasant odour as long as the access of air was prevented. Some meat placed in water, even in an hermetically closed bottle, was rotten in a few days.

The odour *sui generis* presented, on contact with the air, by meat which has been preserved for a time in the borax solution, seems to me to arise from the decomposition of the materials resulting from the metamorphosis of the substances composing either the muscular fibre or the intermuscular plasma.

Without wishing to infer from the preceding an application to the preservation of viands for culinary use, there flows from it another—the preservation of anatomical preparations by means of concentrated solutions of borax in well-closed jars. A great saving of the alcohol used in such cases would evidently result.

As we have demonstrated that protoplasm (that is to say, the living substratum of the lower organisms) is killed by borax, this substance might probably be utilized in the dressing of wounds, &c. —*Annales de Chimie et de Physique*, April 1875, pp. 543–549.